PRELIMINARY

OPERATING AND SERVICING MANUAL

MODEL 5232A/5532A

ELECTRONIC COUNTER

Serials Prefixed: 135-

GENERAL ELECTRONIC
Instrumentation &
228 . Florence
Inglewood, Calif. 90301

H. Fujimoto
JUN 27 1962

Copyright HEWLETT-PACKARD COMPANY 1961
1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

01142-1

Printed: Sept. 1961

SPECIFICATIONS

MAXIMUM COUNTING RATE	1.2 mc
REGISTRATION	
Number of Digits:	Six
Display:	Model 5232A; neon column Model 5532A; long-life Nixie tubes
INPUT SENSITIVITY	0.1 volt rms sine wave; 1.0 volt negative pulse, 0.2 μsec minimum width
INPUT IMPEDANCE	Approximately 1 megohm shunted by 50 pf
OPERATING TEMPERATURE RANGE	-20 to +65°C
TIME BASE	
Long-Term Stability:	±3 parts in 10^7 per month
Short-Term Stability:	±2 parts in 10^6 (+10 to +50°C) ±20 parts in 10^6 (-20 to +65°C)
FREQUENCY MEASUREMENT	
Range:	2 cps to 1.2 mc
Accuracy:	±1 count, ± time base accuracy
Reads In:	kc with positioned decimal
Gate Times:	10, 1, 0.1, 0.01 seconds
PERIOD MEASUREMENT	
Range:	2 cps to 10 kc in single period; 2 cps to 100 kc in 10 period average; 2 cps to 1 mc in 100 period average and above

SPECIFICATIONS (Cont'd)

PERIOD MEASUREMENT (Cont'd)

Accuracy:	±1 μsec, ± time base accuracy, ±trigger error/periods averaged *
Reads In:	milliseconds and microseconds with positioned decimal point
Periods Averaged:	1, 10, 10^2, 10^3, 10^4, or 10^5
Self-Check:	measures period of 1 mc

RATIO MEASUREMENT

Reads:	(f_1 / f_2) x period multiplier
Range:	f_1: 100 cps to 1.2 mc (1 volt rms into 500 ohms) f_2: same as period
Accuracy:	±1 count of f_1, ± trigger error of f_2

OUTPUT	4-line BCD (1-2-2-4)
Impedance:	100K ohms on each line
Level:	"0" state indicated by approximately -24 volts; "1" state by -1 volt
Print Command:	+28 volts, dc coupled from 2700 ohms source
Hold-Off Requirements:	Positive voltage not exceeding +12 volts. May be anywhere from ground to +12 volts.
DIMENSIONS	16-3/4 in. wide, 3-1/2 in. high, 11-1/2 in. deep
NET WEIGHT	15 pounds
POWER REQUIREMENTS	115 or 230 volts ±10%, 50 to 60 cps**, 35 watts

* Trigger error for sine wave inputs at rated 0.1 volt rms sensitivity may be stated as ±0.3% maximum for signals of 40 db signal-to-noise ratio.

** Operation with line frequency range of 50 to 1000 cps available on special order.

TABLE OF CONTENTS

Section		Page
I	DESCRIPTION AND INSTALLATION	1-1
	1-1. General Description	1-1
	1-3. Inspection	1-1
	1-6. Installation	1-1
II	OPERATION	2-1
	2-1. Controls and Terminals	2-1
	2-10. Measurements	2-2
III	MAINTENANCE	3-1
	3-1. Introduction	3-1
	3-3. Troubleshooting	3-1

LIST OF SCHEMATIC DIAGRAMS

Figure		Page
3-1.	Overall Schematic 5232A/5532A, includes Gate Assembly 5212A-65D (A17) and Display Control Assembly 5212A-65E (A18)..	3-6
3-2.	Amplifier Assembly 5232A-65F (A1) and Trigger Assembly 5232A-65E (A2)	3-9
3-3.	Decimal Counter Assembly 5232A-A4 (A3)	3-11
3-4.	Decimal Counter Assembly 5532A-A4 (A3)	3-13
3-5.	Decimal Counter Assembly 5212A-4A (A4-A8) .	3-15
3-6.	Decimal Counter Assembly 5512A-4A (A4-A8) .	3-17
3-7.	Oscillator Assembly 5232A-65D (A9)	3-19
3-8.	Decade Divider Assembly 5232A-65C (A10)....	3-21
3-9.	Decade Divider Assembly 5212A-65C (A11-A16)	3-23
3-10.	Power Supply Assembly 5212A-65G (A19) . . .	3-25

SECTION I

DESCRIPTION AND INSTALLATION

1-1. GENERAL DESCRIPTION.

1-2. The Hewlett-Packard Model 5232A/5532A Electronic Counter measures frequencies from 2 cycles to 1.2 mc, period average up to 10^5 periods, and the ratio of two frequencies. The measurement is displayed on a six-place digital readout. The instrument includes a self-check provision for both frequency and period measurement modes. The 5232A/5532A are basically similar: the 5232A has a neon column readout and the 5532A has an in-line nixie readout.

1-3. INSPECTION.

1-4. Unpack and inspect the Model 5232A/5532A as soon as possible after receipt. Save all packing materials until inspection is complete to simplify reshipment, if required.

1-5. Inspect and operate the instrument as soon as possible after unpacking (refer to paragraph 2-12). If there is any indication of damage, immediately notify the carrier. Procedures and general shipping instructions are described on the warranty sheet included with this manual.

1-6. INSTALLATION.

1-7. COOLING. The Model 5232A/5532A uses a forced-air cooling system. The air intake and filter are located on the rear panel of the instrument. Inspect the filter regularly; clean the filter before it becomes dirty enough to restrict air flow.

1-8. 115 or 230 VOLT OPERATION. A switch located on the rear panel converts the instrument to either 115-volt or 230-volt operation. To change switch position, insert thin-bladed screwdriver in slot on switch and slide switch towards desired operating position. The switch will snap into position. The instrument is in 115-volt operation when 115 appears on the switch; 230-volt operation when 230 appears on the switch. A 0.6-ampere slow-blow fuse should be used for 115-volt operation; a 0.3-ampere slow-blow fuse for 230-volt operation.

CAUTION

Before applying power to the instrument check 115/230 volt switch for proper setting to avoid possible damage.

1-9. POWER CABLE. The three-conductor power cable supplied with the 5232A/5532A terminates in a polarized three-prong male connector recommended by the National Electrical Manufacturers' Association. The third contact is an offset round pin added to a standard two-blade connector. The third contact grounds the instrument chassis when used with an appropriate receptacle. An adapter can be used to connect the plug to a standard two-contact receptacle. The ground connection then terminates a short lead (usually green) from the adapter. This lead should be connected to a suitable ground to eliminate the possibility of shock to operation personnel.

SECTION II
OPERATION

2-1. CONTROLS AND TERMINALS.

2-2. FUNCTION SELECTOR. The designations on the left side of the FUNCTION SELECTOR switch pertain to period and ratio measurements; the designation on the right to frequency and manual measurements.

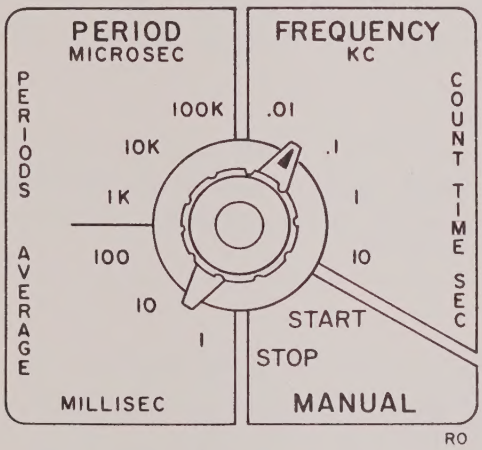


Figure 2-1. Function Selector Switch

2-3. SENSITIVITY SWITCH. The SENSITIVITY switch is an attenuator which permits measurements over a wide range of voltages; attenuating the input signal by a factor of 100 in steps of .1, .3, 1, 3, and 10 volts.

2-4. DISPLAY CONTROL. In the NON-STORAGE mode, the DISPLAY control will vary the display time from 0.2 to over 5 seconds. If the DISPLAY control is switched to INFINITE, the count will be displayed indefinitely or until the counting cycle is started again by depressing the RESET button. In STORAGE mode, the DISPLAY control adjusts the sampling rate of the instrument. A continuous display will be presented while the instrument is totalizing a new count and will change only when the new count differs from the previous count.

2-5. DISPLAY LAMP. The DISPLAY neon lamp located on the front panel lights while the signal gate is open.

2-6. RESET. When the RESET button is depressed, the readout and internal count are returned to zero and a new counting cycle is ready to start.

2-7. EXTERNAL STANDARD. To use an external frequency standard in place of the internal oscillator, set the EXT switch on the rear of the instrument to the down position, and connect the external standard to the BNC connector below the EXT switch. The signal must be at least 1 volt rms. When the EXT switch is in the up position, 1-mc signal from the internal oscillator is available from the connector for external use.

2-8. STORAGE. The display storage feature provides a continuous visual display while the instrument is totalizing a new count. Only if the new count differs from the previous count will the display change, in which case the count will shift directly to the new reading. The storage feature can be disabled with switch on rear panel.

2-9. DIGITAL RECORDER OUTPUT. The rear mounted DIGITAL RECORDER connector (50-pin) permits direct connection to the hp Model 562A Digital Recorder. Other data handling systems can also be connected to the DIGITAL RECORDER output.

2-10. MEASUREMENTS.

2-11. INSTRUMENT WARM-UP. Because the 5232A/5532A is transistorized, little warm-up time is required; 10 seconds is sufficient.

2-12. SELF-CHECK. When the SENSITIVITY control is set to CHECK, the 5232A/5532A will automatically count from its own standard frequency. Before making any measurements, it is desireable to check the performance of the 5232A/5532A by means of the checking circuit. Proceed as follows:

a. Set SENSITIVITY switch to the CHECK position.

b. Set function selector to the 1 PERIOD position.

c. Set DISPLAY control fully counterclockwise.

d. Set STORAGE switch to the storage position.

e. Set EXT switch to the up position.

f. Rotate function selector clockwise through all period and frequency positions. Table 2-1 shows the proper display for each switch setting.

Table 2-1. Readings for Check Mode

Position	Display
1 period	No self check at 1 period position
10 periods	00.0010
100 periods	0.00100
1K periods	001.000
10K periods	01.0000
100K periods	1.00000
0.01 sec	00100.0
0.1 sec	0100.00
1.0 sec	100.000
10 sec	00.0000
MANUAL START	Continuous 10 cps counting

2-13. FREQUENCY MEASUREMENT. When the function selector is in a FREQUENCY position, the 5232A/5532A will count and display the frequency of the incoming waveform directly. To measure an unknown frequency of unknown amplitude, proceed as follows:

a. Set EXT to the up position.

b. Set SENSITIVITY switch to the 10 VOLT RMS position.

c. Set function selector switch to any FREQUENCY position.

d. Connect unknown frequency to INPUT jack.

e. Turn SENSITIVITY switch clockwise until instrument displays a consistent count. The display reads directly in kilocycles, with decimal point automatically positioned.

2-14. MANUAL GATE. This mode is used for direct long-term counting. To start counting, feed external signal into INPUT connector on front panel and turn function selector to MANUAL START. To stop counting, turn function selector to MANUAL STOP. If the SENSITIVITY switch is in the CHECK position, the instrument will count at a 10 count per second rate. The count will remain displayed until the RESET button is depressed or a new measurement is made.

2-15. PERIOD AND PERIOD AVERAGE. The 5232A/5532A will measure 1 period or the average of 10 through 100,000 periods. To measure PERIOD or PERIOD AVERAGE, proceed as follows:

a. Set function selector switch to PERIOD.

b. Set SENSITIVITY switch to 10 VOLTS RMS position.

c. Connect unknown frequency to INPUT jack.

d. Set EXT switch to up position.

e. Turn SENSITIVITY switch clockwise until instrument displays a consistent count.

2-16. The 5232A/5532A will count the output of the internal oscillator for the period of the unknown signal (1/frequency). When used in PERIOD AVERAGE, the display will be the average of one period even though counting proceeds through many periods. In 10 PERIOD AVERAGE for example, the measured count will be the average period of one cycle, although 10 cycles are measured.

2-17. RATIO MEASUREMENT. The 5232A/5532A can be used to measure the ratio of two frequencies. Ratio measurement is similar to period measurement except that an external signal replaces the time base signal. For ratio measurements proceed as follows:

a. Set function selector to PERIOD.

b. Set SENSTIVITY switch to 10 VOLTS RMS position.

c. Switch EXT to the down position.

d. Connect higher of the two frequencies to EXT jack on rear panel.

e. Connect lower of the two frequencies to INPUT jack.

f. Turn SENSITIVITY switch clockwise until instrument displays a consistent count.

2-18. The 5232A/5532A will display the number of cycles of the higher frequency per cycle of the lower frequency. The higher frequency is counted for a period or period average of the lower frequency.

SECTION III
MAINTENANCE

3-1. INTRODUCTION.

3-2. In troubleshooting the 5232A/5532A a malfunction can usually be isolated to a single board. If spare boards are available, replacement is the most convenient way to localize a faulty section. Decade divider assemblies A11, A12, A13, A14, A15, and A16 are interchangeable; decimal counter assemblies A4, A5, A6, A7, and A8 are also interchangeable. If a malfunction is suspected within a board, components can be checked without removal by using an ohmmeter to check the suspected board against a known good board.

CAUTION

Because of the compact design of the 5232A/5532A, be careful when working on circuit boards or board connections. A probe shorted between two points may cause serious damage to semiconductors. Use care when substituting boards; a board inserted in the wrong socket may damage semiconductors.

3-3. TROUBLESHOOTING PROCEDURE.

3-4. TEST EQUIPMENT. Refer to table 3-1 for recommended test equipment.

Table 3-1. Recommended Test Equipment

Instrument	Use	Recommended Instrument
DC Electronic Voltmeter (2 to 200 volt range)	Voltage and resistance measurement	hp Model 410B Vacuum Tube Voltmeter
Oscilloscope	Waveform observation	hp Model 150A Oscilloscope with hp Model 152B Dual Trace Amplifier
Oscillator (variable 10 to 100,000 cycles)	Input signal frequency	hp Model 650A Test Oscillator

3-5. POWER SUPPLY. The power supply is quite stable and will seldom require adjustment; do not adjust unless supply voltages are outside the tolerance limits (see table 3-2).

Table 3-2. Power Supply Voltages

Supply	Adjustment	Range	Measure at XA17 Pin No.
-35	R7	-34.65 to -35.35	15
+150	none	+140 to +160	14
-150	none	-140 to -160	3
-2.4	none	-1.9 to -2.9	13
-26.5	none	-25.5 to -27.5	12
All voltages referenced to ground			

3-6. If trouble is suspected or if the instrument will not comply to the self-check procedure in section II, a board-by-board check can be made using the following procedure:

a. Remove gate control board A17.

b. Remove display control board A18.

c. Set SENSITIVITY switch to .1 VOLT RMS position.

d. Set function selector to FREQUENCY .01 SECONDS.

e. Set DISPLAY control full counterclockwise.

f. Set EXT switch to the up position.

g. Connect 1 mc, 100 mv signal to INPUT jack.

3-7. INPUT ATTENUATOR, AMPLIFIER, AND SCHMITT TRIGGER (A1 and A2). Connect oscilloscope to center conductor of coaxial cable at upper left terminal on front wafer of function selector switch. The waveform should be a 1-mc rectangular wave approximately 25 volts peak-to-peak.

3-8. COUNTING SECTION OF READOUT BOARDS. Note: All voltages given are approximate.

a. To check decimal counter assembly A3, connect oscilloscope to XA3 pin 7. A 1-mc square wave, 29 volts peak-to-peak should be present. Connect oscilloscope to XA3 pin 10. A 100-kc square wave, 26 volts should be present.

b. To check decimal counter assembly A4, connect oscilloscope to XA4, pin 10. A 10-kc square wave, 26 volts peak-to-peak should be present.

c. To check decimal counter assembly A5, connect oscilloscope to XA5, pin 10. A 1-kc square wave, 26 volts peak-to-peak should be present.

d. To check decimal counter assembly A6, connect oscilloscope to XA6, pin 10. A 100-cps square wave, 26 volts peak-to-peak should be present.

e. To check decimal counter assembly A7, connect oscilloscope to XA7, pin 10. A 10-cps square wave, 26 volts peak-to-peak should be present.

f. To check decimal counter assembly A8, connect oscilloscope to XA8, pin 10. A 1-cps square wave, 26 volts peak-to-peak should be present.

3-9. READOUT SECTION OF READOUT BOARDS.

a. Connect 10 cps to INPUT jack. Units readout should count at a 10 count-per-second rate. Tenths readout should count a a 1 count-per second rate.

b. Connect 100 cps to INPUT jack. Hundreds readout should count at a 1 count-per-second rate.

c. Connect 1000 cps to INPUT jack. Thousands readout should count at a 1 count-per-second rate.

d. Connect 10,000 cps to INPUT jack. Ten-thousands readout should count at a 1 count-per-second rate.

e. Connect 100,000 cps to INPUT jack. Hundred-thousands readout should count at a 1 count-per-second rate.

3-10. OSCILLATOR AND DECADE DIVIDER BOARDS. Note: All voltages given are approximate.

a. To check oscillator board A9, connect oscilloscope to XA9, pin 1. A 1-mc square wave, 25 volts peak-to-peak from Schmitt trigger should be present.

b. To check decade divider A10, connect oscilloscope to XA10, pin 4. A 1-mc square wave, 24 volts peak from internal oscillator should be present. Connect oscilloscope to XA10, pin 14. A 100-kc square wave, 24 volts peak-to-peak should be present.

c. To check decade divider A11, connect oscilloscope to XA11, pin 5. A 10-kc square wave, 24 volts peak-to-peak should be present.

d. To check decade divider A12, connect oscilloscope to XA12, pin 5. A 1-kc square wave, 24 volts peak-to-peak should be present.

e. To check decade divider A13, connect oscilloscope to XA13, pin 5. A 100-cps square wave, 24 volts peak-to-peak should be present.

f. To check decade divider A14, connect oscilloscope to XA14, pin 5. A 10-cps square wave, 24 volts peak-to-peak should be present.

g. To check decade divider A15, connect oscilloscope to XA15, pin 5. A 1-cps square wave, 24 volts peak-to-peak should be present.

h. To check decade divider A16, connect oscilloscope to XA16, pin 5. A 0.1 cps square wave, 24 volts peak-to-peak should be present.

3-11. GATE CONTROL AND DISPLAY CONTROL. Replace control boards A17 and A18. If unit is still not functioning properly, the malfunction is probably in the gate control board A17 or display control board A18. Refer to overall schematic, figure 3-1, for approximate waveforms in control boards. Possible symptoms of troubles in the control boards are:

a. No gate pulse.

b. DISPLAY lamp not lighting properly.

c. No readout when STORAGE switch is turned on.

d. STORAGE switch has no control.

e. No control of instrument with DISPLAY control.

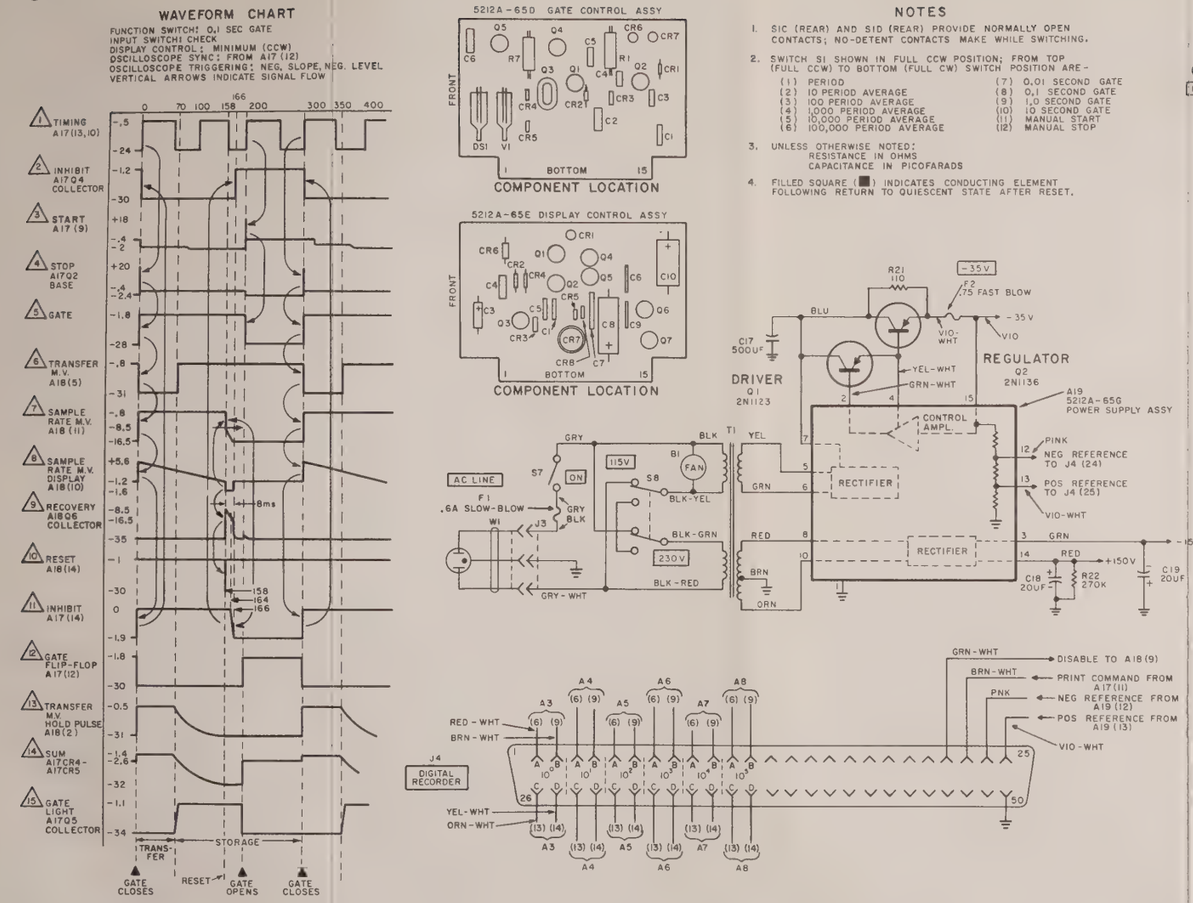
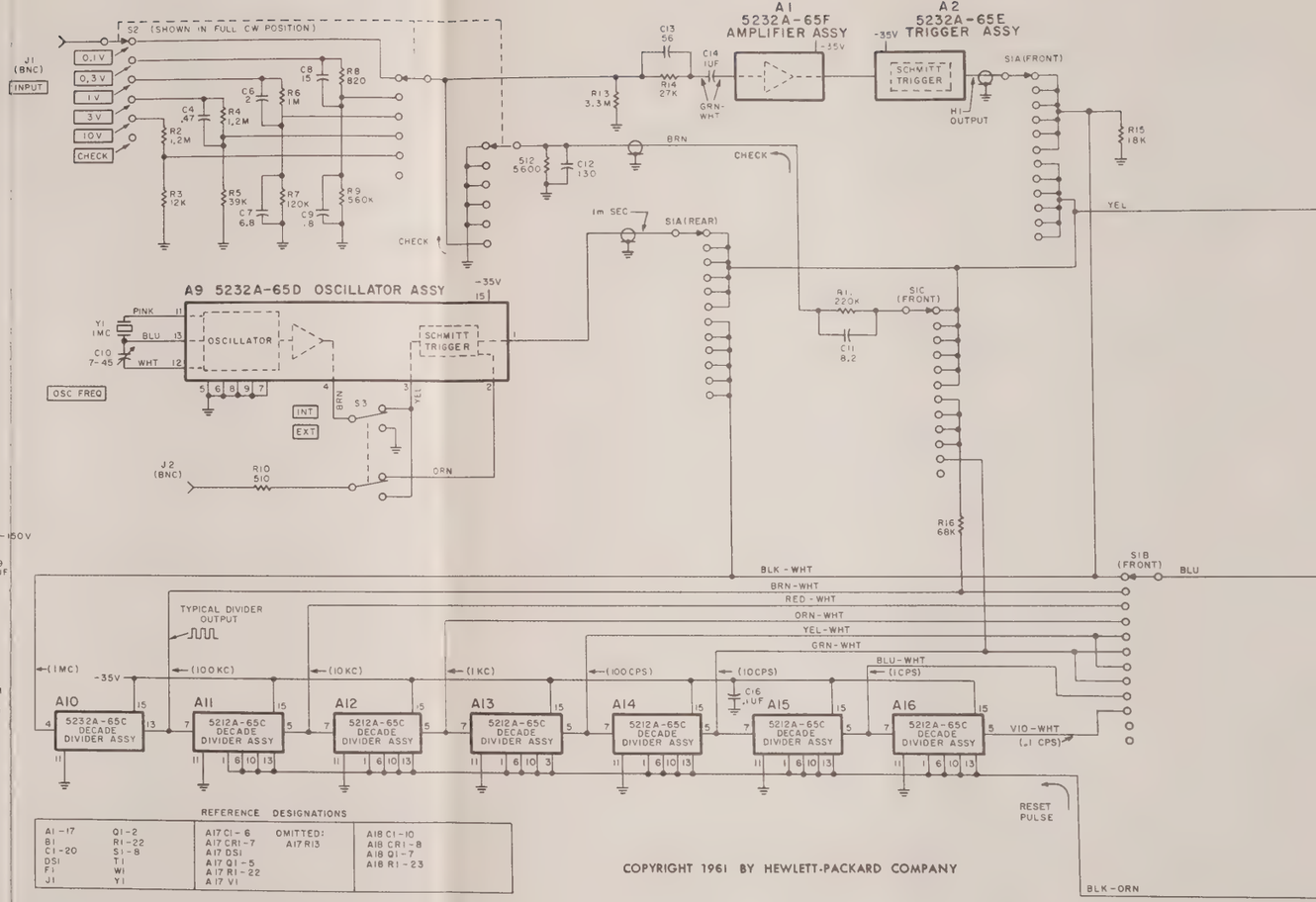

WAVEFORM CHART
FUNCTION SWITCH: 0.1 SEC GATE
INPUT SWITCH: CHECK
DISPLAY CONTROL: MINIMUM (CCW)
OSCILLOSCOPE SYNC: FROM A17 (12)
OSCILLOSCOPE TRIGGERING: NEG. SLOPE, NEG. LEVEL
VERTICAL ARROWS INDICATE SIGNAL FLOW
1 TIMING A17 (13, 10)
2 INHIBIT A17Q4 COLLECTOR
3 START A17 (9)
4 STOP A17Q2 BASE
5 GATE
6 TRANSFER M.V. A18 (5)
7 SAMPLE RATE M.V. A18 (11)
8 SAMPLE RATE M.V. DISPLAY A18 (10)
9 RECOVERY A18Q6 COLLECTOR
10 RESET A18 (14)
11 INHIBIT A17 (14)
12 GATE FLIP-FLOP A17 (12)
13 TRANSFER M.V. HOLD PULSE A18 (2)
14 SUM A17CR4 - A17CR5
15 GATE LIGHT A17Q5 COLLECTOR
8ms
TRANS-FER
STORAGE
GATE CLOSES
RESET
GATE OPENS
GATE CLOSES
5212A-65D GATE CONTROL ASSY
COMPONENT LOCATION
5212A-65E DISPLAY CONTROL ASSY
COMPONENT LOCATION
NOTES
1. SIC (REAR) AND SID (REAR) PROVIDE NORMALLY OPEN CONTACTS; NO-DETENT CONTACTS MAKE WHILE SWITCHING.
2. SWITCH S1 SHOWN IN FULL CCW POSITION; FROM TOP (FULL CCW) TO BOTTOM (FULL CW) SWITCH POSITION ARE -
(1) PERIOD
(2) 10 PERIOD AVERAGE
(3) 100 PERIOD AVERAGE
(4) 1,000 PERIOD AVERAGE
(5) 10,000 PERIOD AVERAGE
(6) 100,000 PERIOD AVERAGE
(7) 0.01 SECOND GATE
(8) 0.1 SECOND GATE
(9) 1.0 SECOND GATE
(10) 10 SECOND GATE
(11) MANUAL START
(12) MANUAL STOP
3. UNLESS OTHERWISE NOTED: RESISTANCE IN OHMS CAPACITANCE IN PICOFARADS
4. FILLED SQUARE (■) INDICATES CONDUCTING ELEMENT FOLLOWING RETURN TO QUIESCENT STATE AFTER RESET.
DRIVER Q1 2N1123
REGULATOR Q2 2N1136
A19 5212A-65G POWER SUPPLY ASSY
AC LINE
F1 .6A SLOW-BLOW
CONTROL AMPL.
RECTIFIER
RECTIFIER
NEG REFERENCE TO J4 (24)
POS REFERENCE TO J4 (25)
+150V
-150V
J4 DIGITAL RECORDER
DISABLE TO A18 (9)
PRINT COMMAND FROM A17 (11)
NEG REFERENCE FROM A19 (12)
POS REFERENCE FROM A19 (13)

FIGURE 3-1
OVERALL SCHEMATIC
(Sheet 1 of 2)



COPYRIGHT 1961 BY HEWLETT-PACKARD COMPANY

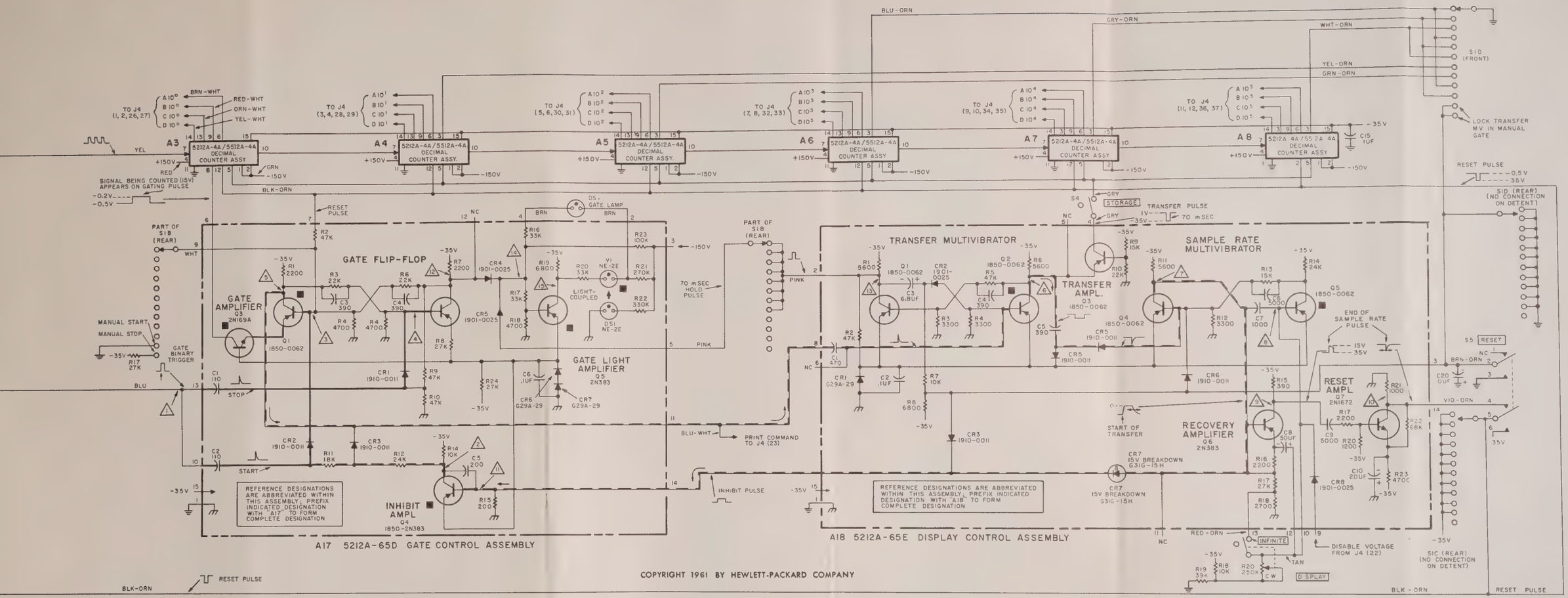
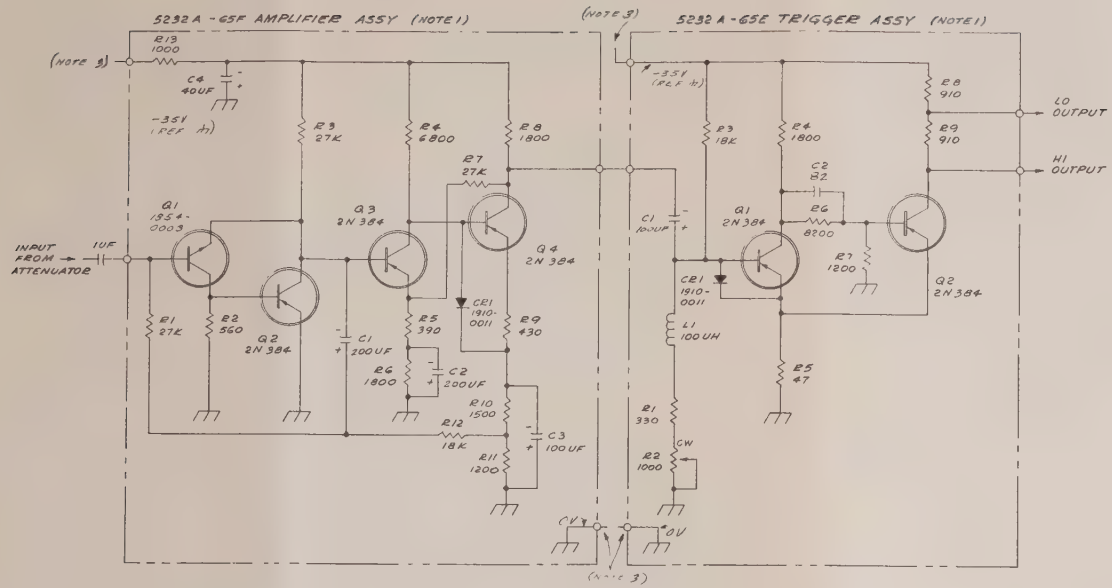


FIGURE 3-1
OVERALL SCHEMATIC
(Sheet 2 of 2)



AMPLIFIER ASSY REFERENCE DESIGNATIONS (NOTE 1)	TRIGGER ASSY REFERENCE DESIGNATIONS (NOTE 1)
C1 - C4 CR1 Q1 - Q4 R1 - R13	C1 CR1 - CR2 L1 Q1 - Q2 R1 - R9

COPYRIGHT 1961 BY HEWLETT-PACKARD COMPANY

This drawing is intended for the operation and maintenance of Hewlett-Packard equipment and is not to be used otherwise or reproduced without written consent of the Hewlett-Packard Company.

5232A-65F -0E
5232A-65E -0E 4/2/61

NOTES

1. REFERENCE DESIGNATIONS WITHIN AMP & TRIG. ASSEMBLY ARE INCOMPLETE; TO FORM COMPLETE REFERENCE DESIGNATION, ADD APPROPRIATE ASSEMBLY DESIGNATION (A_) AS PREFIX TO INDICATED DESIGNATION. ASSEMBLY DESIGNATION IS SHOWN IN FIGURE CAPTION AND ON OVERALL FUNCTIONAL SCHEMATIC.
2. TYPICAL EXTERNAL CONNECTIONS ARE SHOWN; FOR EXACT CONNECTION AND REFERENCE DESIGNATIONS OF EXTERNAL COMPONENTS, REFER TO OVERALL FUNCTIONAL SCHEMATIC.
3. INDICATED POWER SUPPLY VOLTAGES ARE RELATIVE TO ~~th~~ WITHIN ASSEMBLY; FOR VOLTAGES RELATIVE TO INSTRUMENT CHASSIS, REFER TO OVERALL SCHEMATIC OR POWER DISTRIBUTION DIAGRAM.
4. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   RESISTORS 1/4 WATT.

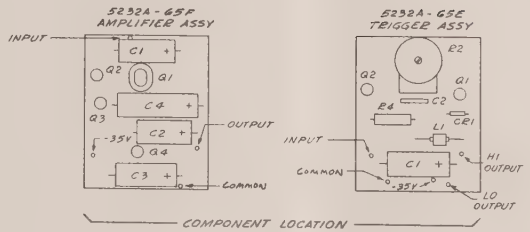
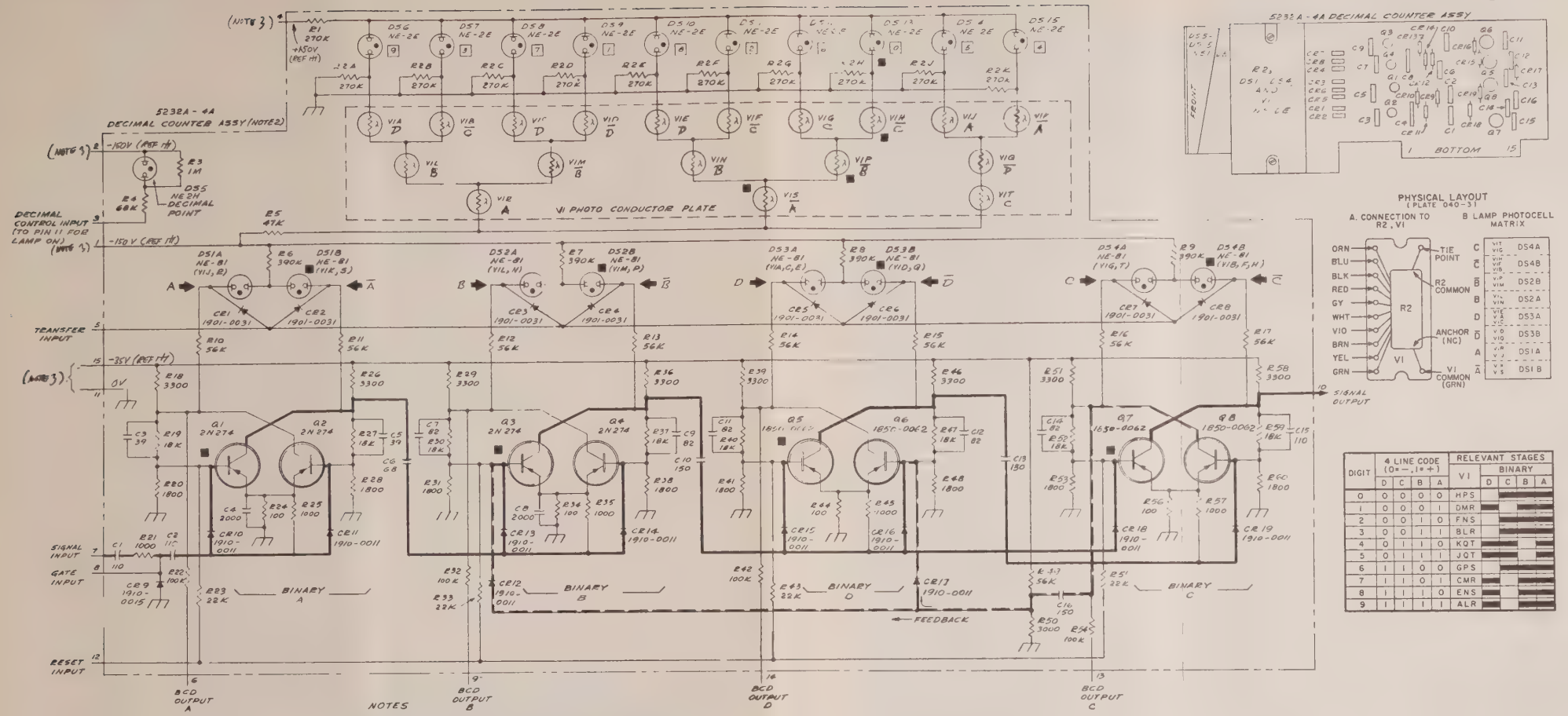


Figure 3-2. Amplifier Assembly 5232A-65F (A1) and Trigger Assembly 5232A-65E (A2)



PHYSICAL LAYOUT
(PLATE 040-31)

DIGIT	4 LINE CODE (0=−, 1=+)				RELEVANT STAGES				
					V1	BINARY			
	D	C	B	A		D	C	B	A
0	0	0	0	0	HPS				
1	0	0	0	1	DMR				
2	0	0	1	0	FNS				
3	0	0	1	1	BLR				
4	0	1	0	0	KQT				
5	0	1	0	1	JQT				
6	1	1	0	0	GPS				
7	1	1	0	1	CMR				
8	1	1	1	0	ENS				
9	1	1	1	1	ALR				

NOTES

1. REFERENCE DESIGNATIONS WITHIN DECIMAL COUNTER ASSEMBLY ARE INCOMPLETE; TO FORM COMPLETE REFERENCE DESIGNATION, ADD APPROPRIATE ASSEMBLY DESIGNATION (A) AS PREFIX TO INDICATED DESIGNATION. ASSEMBLY DESIGNATION IS SHOWN IN FIGURE CAPTION AND ON OVERALL FUNCTIONAL SCHEMATIC.
2. TYPICAL EXTERNAL CONNECTIONS ARE SHOWN; FOR EXACT CONNECTION AND REFERENCE DESIGNATIONS OF EXTERNAL COMPONENTS, REFER TO OVERALL FUNCTIONAL SCHEMATIC.
3. INDICATED POWER SUPPLY VOLTAGES ARE RELATIVE TO ⏚ WITHIN ASSEMBLY; FOR VOLTAGES RELATIVE TO INSTRUMENT CHASSIS, REFER TO OVERALL SCHEMATIC OR POWER DISTRIBUTION DIAGRAM.
4. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; RESISTORS 1/4 WATT.
5. REFERENCE DESIGNATIONS IN PARENTHESES INDICATE LIGHT DESTINATION FOR DS1-DS4. LIGHT SOURCE IS NOTED NEAR EACH V1 SECTION.
6. FILLED SQUARE (■) INDICATES CONDUCTING ELEMENT FOR DECIMAL "0" (BCD "0000").

REFERENCE DESIGNATIONS (NOTE 1)

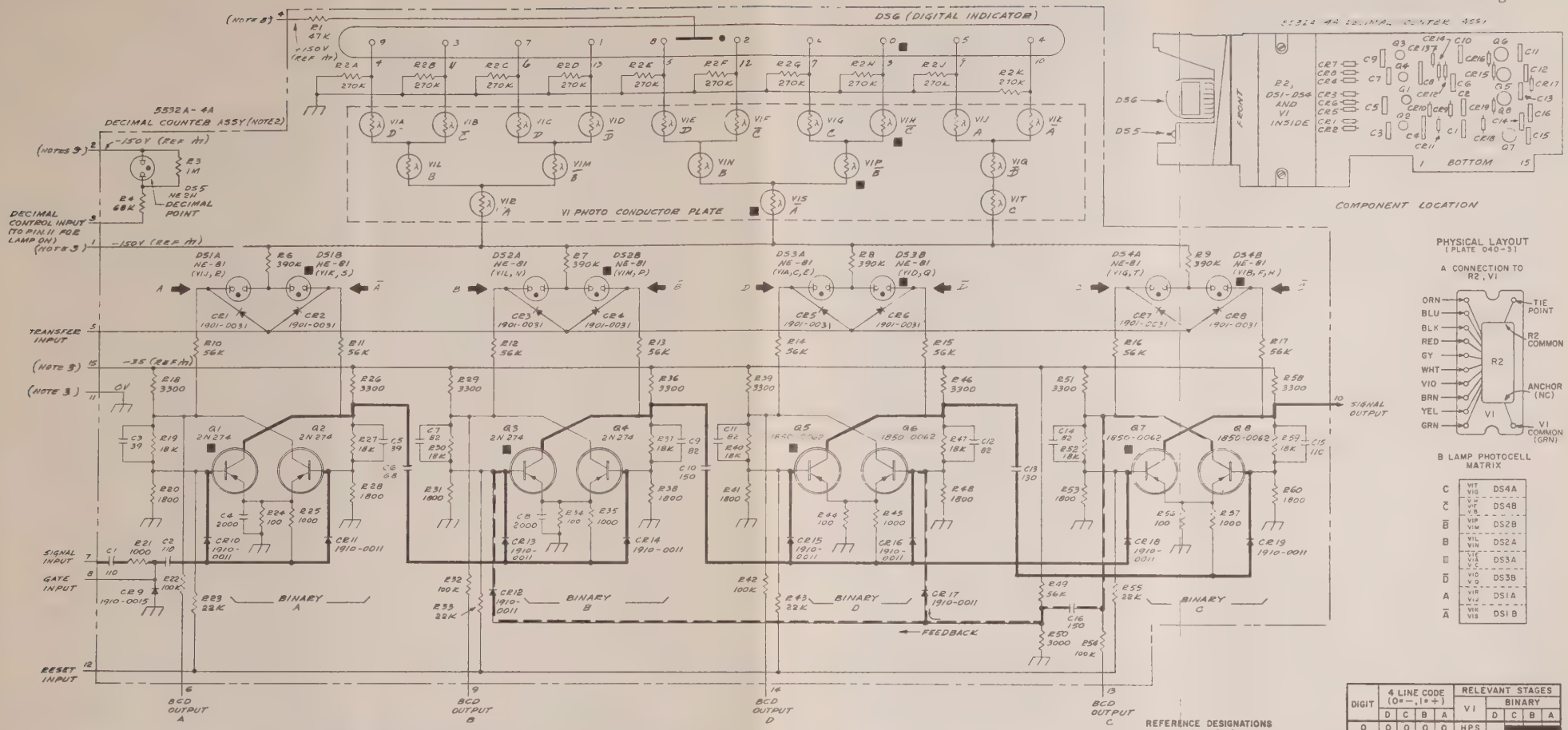
C1 - 16
CR1 - 19
DS1 - 15
Q1 - 9
R1 - 60
V1

COPYRIGHT 1961 BY HEWLETT-PACKARD COMPANY

This drawing is intended for the operation and maintenance of Hewlett-Packard equipment and is not to be used otherwise or reproduced without written consent of the Hewlett-Packard Company.

5232A-4A-1

FIGURE 3-3
DECIMAL COUNTER ASSEMBLY
5232A-4A (A3)



NOTES

1. REFERENCE DESIGNATIONS WITHIN DECIMAL-COUNTER ASSEMBLY ARE INCOMPLETE; TO FORM COMPLETE REFERENCE DESIGNATION, ADD APPROPRIATE ASSEMBLY DESIGNATION (A) AS PREFIX TO INDICATED DESIGNATION. ASSEMBLY DESIGNATION IS SHOWN IN FIGURE CAPTION AND ON OVERALL FUNCTIONAL SCHEMATIC.
2. TYPICAL EXTERNAL CONNECTIONS ARE SHOWN; FOR EXACT CONNECTION AND REFERENCE DESIGNATIONS OF EXTERNAL COMPONENTS, REFER TO OVERALL FUNCTIONAL SCHEMATIC.
3. INDICATED POWER SUPPLY VOLTAGES ARE RELATIVE TO ⏚ WITHIN ASSEMBLY; FOR VOLTAGES RELATIVE TO INSTRUMENT CHASSIS, REFER TO OVERALL SCHEMATIC OR POWER DISTRIBUTION DIAGRAM.
4. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   RESISTORS 1/4 WATT.
5. REFERENCE DESIGNATIONS IN PARENTHESES INDICATE LIGHT DESTINATION FOR DS1-DS4; LIGHT SOURCE IS NOTED NEAR EACH V1 SECTION.
6. FILLED SQUARE (■) INDICATES CONDUCTING ELEMENT FOR DECIMAL "0" (BCD "0000").

COPYRIGHT 1961 BY HEWLETT-PACKARD COMPANY
5532A-44 4/1/61

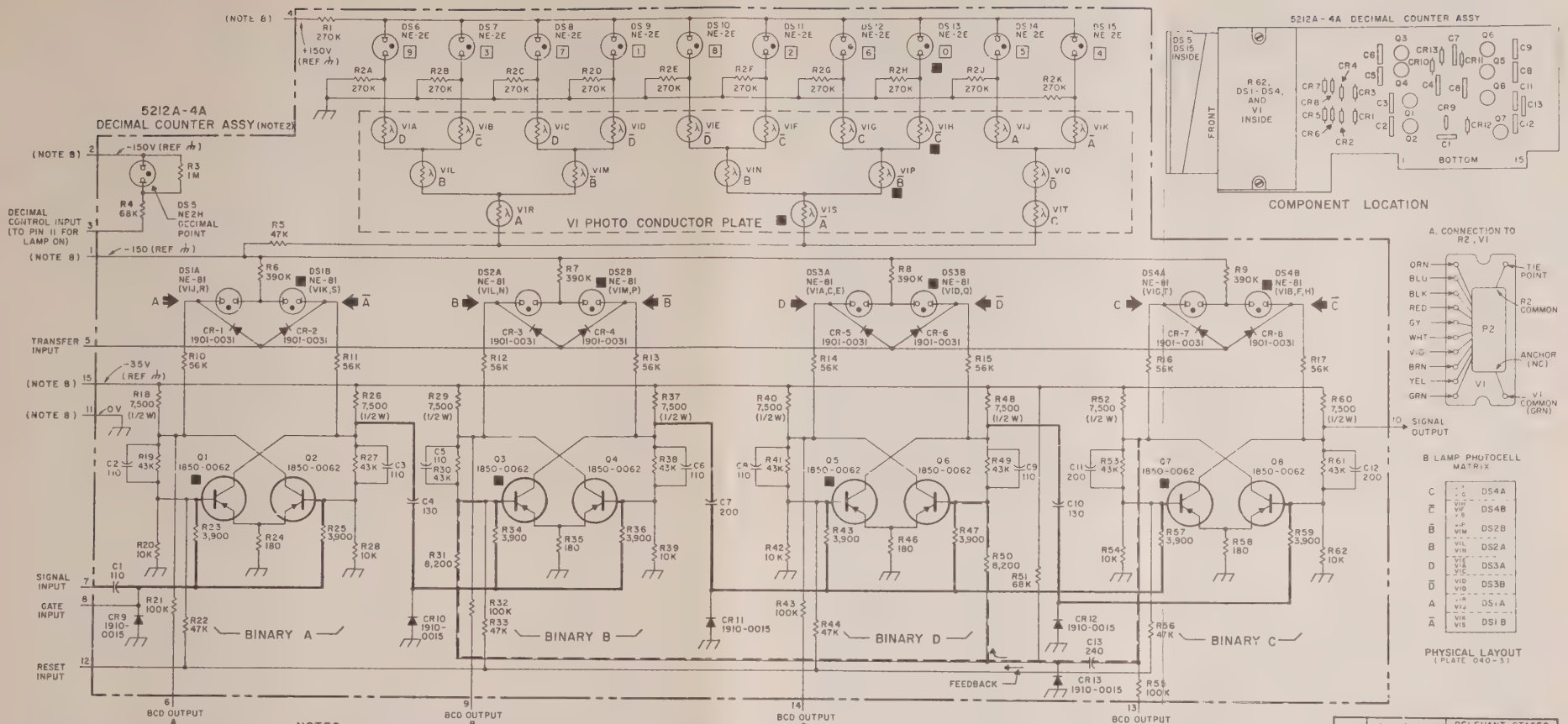
REFERENCE DESIGNATIONS (NOTE 1)

CR1 -
DS1 -
Q1 -
R1 -
V1

OMITTED: R5

DIGIT	4 LINE CODE (0=−, 1=+)				RELEVANT STAGES				
					V1	BINARY			
	D	C	B	A		D	C	B	A
0	0	0	0	0	HPS	■		■	■
1	0	0	0	1	DMR	■			■
2	0	0	1	0	FNS	■		■	
3	0	0	1	1	BLR	■			
4	0	1	1	0	KQT	■	■		
5	0	1	1	1	JQT	■	■		■
6	1	1	0	0	GPS	■	■	■	
7	1	1	0	1	CMR	■	■	■	■
8	1	1	1	0	ENS	■	■	■	
9	1	1	1	1	ALR	■	■		■

FIGURE 3-4
DECIMAL COUNTER ASSEMBLY
5532A-4A (A3)



NOTES

1. REFERENCE DESIGNATIONS IN PARENTHESES INDICATE LIGHT DESTINATION FOR DS1-DS4; LIGHT SOURCE IS NOTED NEAR EACH VI SECTION
2. REFERENCE DESIGNATIONS WITHIN DECIMAL COUNTER ASSEMBLY ARE INCOMPLETE; TO FORM COMPLETE REFERENCE DESIGNATION, AND APPROPRIATE ASSEMBLY DESIGNATION (A_) AS PREFIX TO INDICATED DESIGNATION, ASSEMBLY DESIGNATION IS SHOWN IN FIGURE CAPTION AND ON OVERALL FUNCTIONAL SCHEMATIC.
3. RESISTORS 1/4W UNLESS OTHERWISE NOTED.
4. FOR DS1-DS4, SECTION A LIGHTS ON "1", SECTION B LIGHTS ON "0"
5. TYPICAL EXTERNAL CONNECTION ARE SHOWN; FOR EXACT CONNECTION AND REFERENCE DESIGNATIONS OF EXTERNAL COMPONENTS, REFER TO OVERALL FUNCTIONAL SCHEMATIC.
6. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS
7. FILLED SQUARE (■) INDICATES CONDUCTING ELEMENT FOR DECIMAL "0" (BCD "0000").
8. INDICATED POWER SUPPLY VOLTAGES ARE RELATIVE TO ⏚ WITHIN ASSEMBLY; FOR VOLTAGES RELATIVE TO INSTRUMENT CHASSIS, REFER TO OVERALL SCHEMATIC OR POWER DISTRIBUTION DIAGRAM

REFERENCE DESIGNATIONS (NOTE 2)

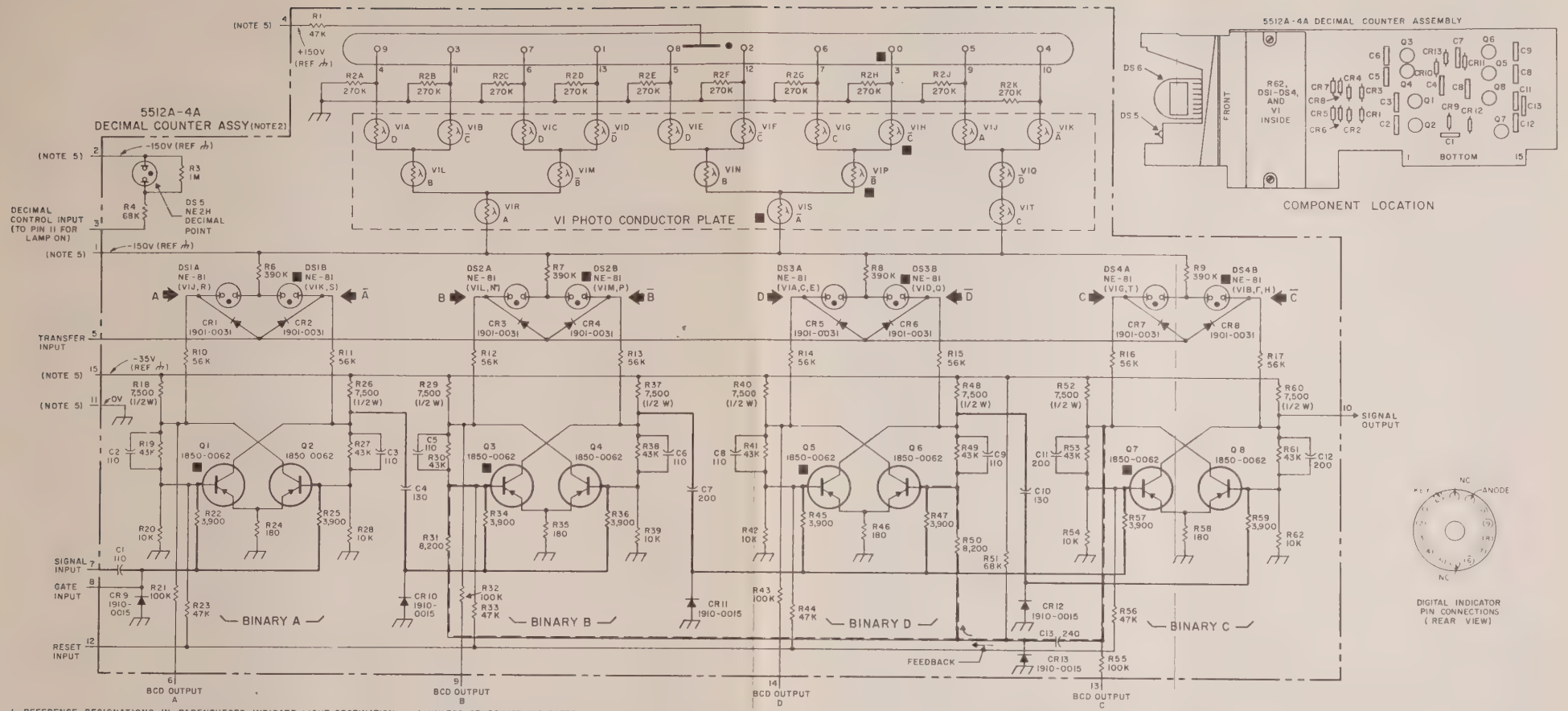
C1 - 13
CR1 - 13
DS1 - 15
Q1 - 8
R1 - 62
VI

DIGIT	4 LINE CODE (0=−, 1=+)				RELEVANT STAGES				
	D	C	B	A	VI	BINARY D	BINARY C	BINARY B	BINARY A
0	0	0	0	0	HPS				
1	0	0	0	1	DMR				■
2	0	0	1	0	FNS			■	
3	0	0	1	1	BLR			■	■
4	0	1	0	0	KQT		■		
5	0	1	0	1	JQT		■		■
6	0	1	1	0	GPS		■	■	
7	0	1	1	1	CMR		■	■	■
8	1	0	0	0	FNS	■			
9	1	0	0	1	ALR	■			■

COPYRIGHT 1961 BY HEWLETT-PACKARD COMPANY

This drawing is intended for the operation and maintenance of Hewlett-Packard equipment and is not to be used otherwise or reproduced without written consent of the Hewlett-Packard Company.
5212A-4A 8/4/61

FIGURE 3-5
DECIMAL COUNTER ASSEMBLY
5212A-4A (A4-A8)



1. REFERENCE DESIGNATIONS IN PARENTHESES INDICATE LIGHT DESTINATION FOR DSI-DS4; LIGHT SOURCE IS NOTED NEAR EACH VI SECTION
2. REFERENCE DESIGNATIONS WITHIN DECIMAL COUNTER ASSY ARE INCOMPLETE; TO FORM COMPLETE REFERENCE DESIGNATION, ADD APPROPRIATE ASSEMBLY DESIGNATION (A_) AS PREFIX TO INDICATED DESIGNATION; ASSEMBLY DESIGNATION IS SHOWN IN FIGURE CAPTION AND ON OVERALL FUNCTIONAL SCHEMATIC
3. TYPICAL EXTERNAL CONNECTIONS ARE SHOWN; FOR EXACT CONNECTION AND REFERENCE DESIGNATIONS OF EXTERNAL COMPONENTS, REFER TO OVERALL FUNCTIONAL SCHEMATIC; SEE NOTE 5.
4. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS
5. INDICATED POWER SUPPLY VOLTAGES ARE RELATIVE TO ⏚ WITHIN ASSEMBLY; FOR VOLTAGES RELATIVE TO INSTRUMENT CHASSIS, REFER TO OVERALL SCHEMATIC OR POWER DISTRIBUTION DIAGRAM
6. RESISTORS 1/4 WATT UNLESS OTHERWISE NOTED.
7. FOR DSI-DS4, SECTION A LIGHTS ON "1," SECTION B LIGHTS ON "0"
8. FILLED SQUARE (■) INDICATES CONDUCTING ELEMENT FOR DECIMAL "0" (BCD "0000")

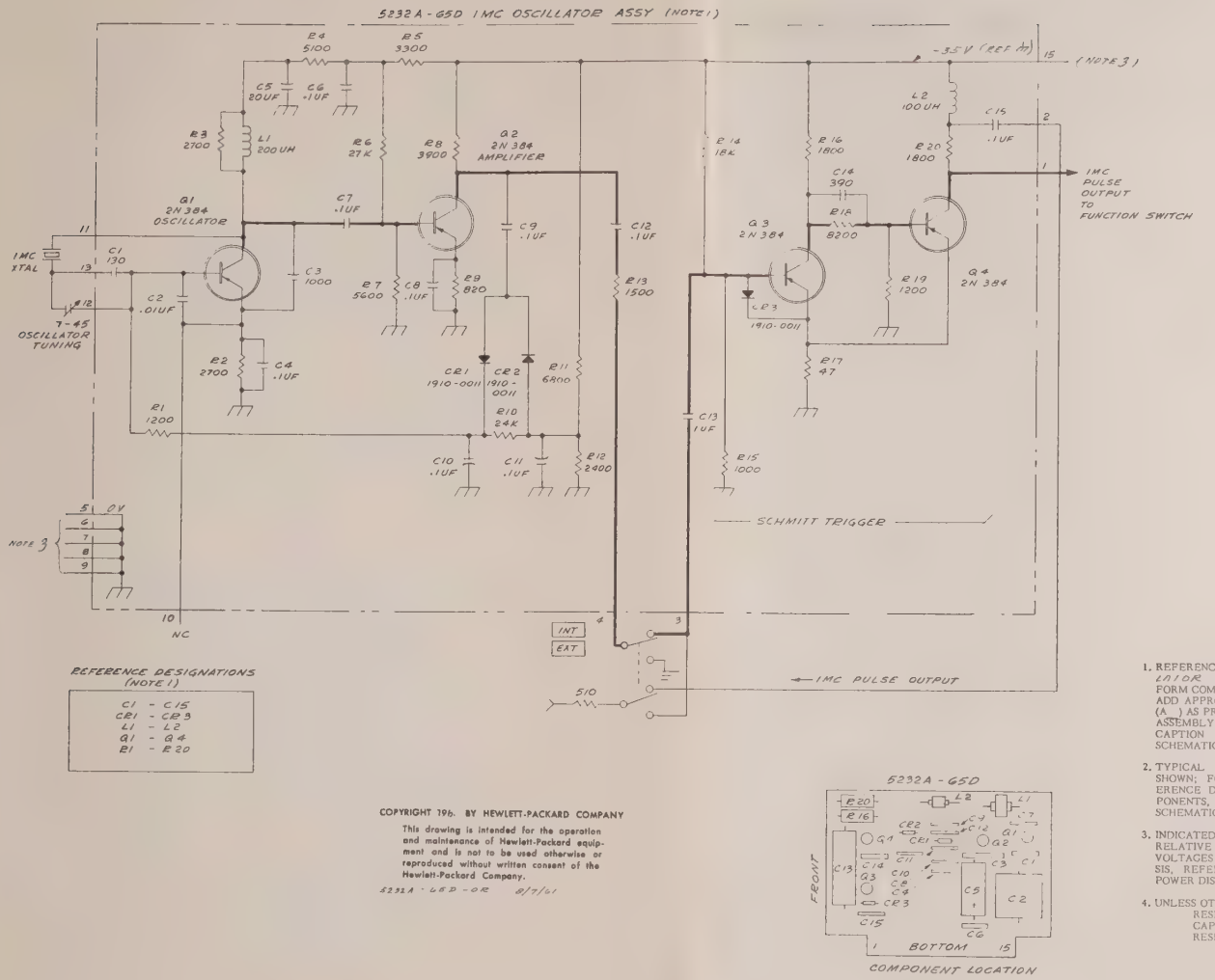
REFERENCE DESIGNATIONS (NOTE 2)

C1 – 13
CR1 – 13
DS1 – 6
Q1 – 8
R1 – 62
VI
OMITTED:
R5

COPYRIGHT 1961 BY HEWLETT-PACKARD COMPANY

This drawing is intended for the operation and maintenance of Hewlett-Packard equipment and is not to be used otherwise or reproduced without written consent of the Hewlett-Packard Company.
5512A-4A M/1/61

FIGURE 3-6
DECIMAL COUNTER ASSEMBLY
5512A-4A (A4-A8)



REFERENCE DESIGNATIONS (NOTE 1)

C1	- C15
CR1	- CR3
L1	- L2
Q1	- Q4
R1	- R20

COPYRIGHT 196. BY HEWLETT-PACKARD COMPANY

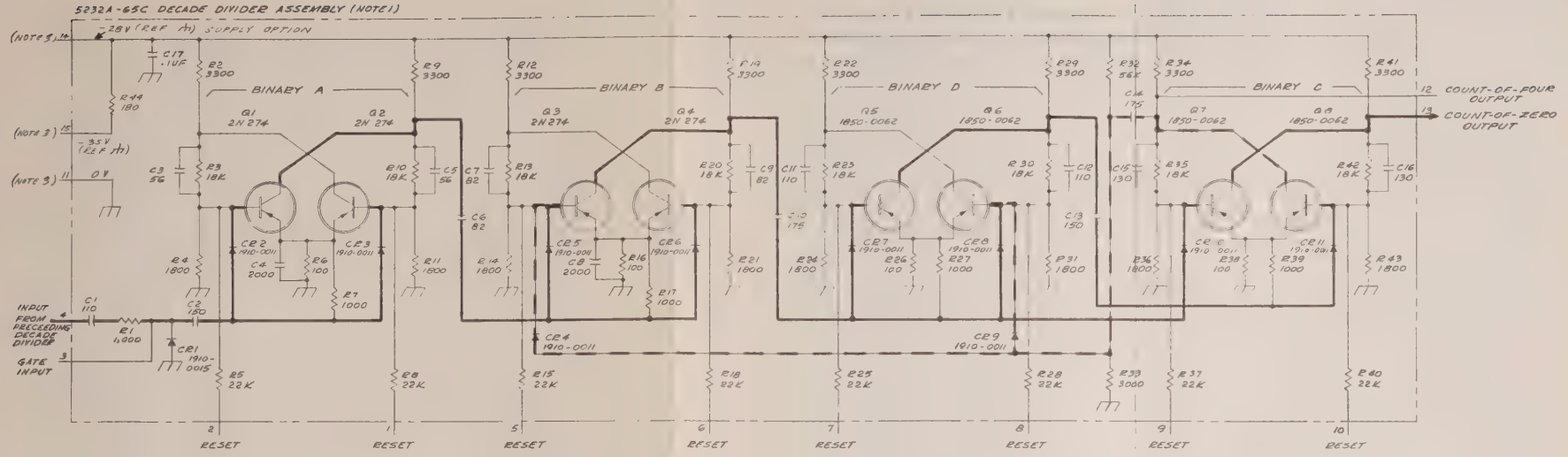
This drawing is intended for the operation and maintenance of Hewlett-Packard equipment and is not to be used otherwise or reproduced without written consent of the Hewlett-Packard Company.

5232A-65D-OR 8/7/61

NOTES

1. REFERENCE DESIGNATIONS WITHIN OSCILLATOR ASSEMBLY ARE INCOMPLETE; TO FORM COMPLETE REFERENCE DESIGNATION, ADD APPROPRIATE ASSEMBLY DESIGNATION (A) AS PREFIX TO INDICATED DESIGNATION. ASSEMBLY DESIGNATION IS SHOWN IN FIGURE CAPTION AND ON OVERALL FUNCTIONAL SCHEMATIC.
2. TYPICAL EXTERNAL CONNECTIONS ARE SHOWN; FOR EXACT CONNECTION AND REFERENCE DESIGNATIONS OF EXTERNAL COMPONENTS, REFER TO OVERALL FUNCTIONAL SCHEMATIC.
3. INDICATED POWER SUPPLY VOLTAGES ARE RELATIVE TO ⏚ WITHIN ASSEMBLY; FOR VOLTAGES RELATIVE TO INSTRUMENT CHASSIS, REFER TO OVERALL SCHEMATIC OR POWER DISTRIBUTION DIAGRAM.
4. UNLESS OTHERWISE INDICATED
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   RESISTORS 1/4 WATT.

Figure 3-7. Oscillator Assembly 5232A-65D (A9)



NOTES

1. REFERENCE DESIGNATIONS WITHIN *DECADE DIVIDER* ASSEMBLY ARE INCOMPLETE; TO FORM COMPLETE REFERENCE DESIGNATION, ADD APPROPRIATE ASSEMBLY DESIGNATION (A) AS PREFIX TO INDICATED DESIGNATION, ASSEMBLY DESIGNATION IS SHOWN IN FIGURE CAPTION AND ON OVERALL FUNCTIONAL SCHEMATIC.
2. TYPICAL EXTERNAL CONNECTIONS ARE SHOWN; FOR EXACT CONNECTION AND REFERENCE DESIGNATIONS OF EXTERNAL COMPONENTS, REFER TO OVERALL FUNCTIONAL SCHEMATIC.
3. INDICATED POWER SUPPLY VOLTAGES ARE RELATIVE TO ⏚ WITHIN ASSEMBLY; FOR VOLTAGES RELATIVE TO INSTRUMENT CHASSIS, REFER TO OVERALL SCHEMATIC OR POWER DISTRIBUTION DIAGRAM.
4. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   RESISTORS 1/4 WATT.

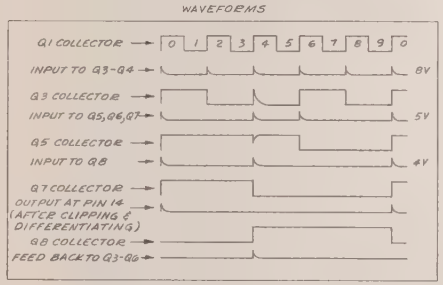
RESET WIRING

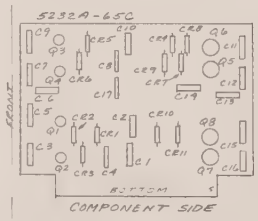
RESET NUMERAL	RESET PULSE (NEGATIVE) PIN CONNECTIONS			
0	2	5	7	9
1	1	5	7	9
2	2	6	7	9
3	1	6	7	9
4	2	6	7	10
5	1	6	7	10
6	2	5	8	10
7	1	5	8	10
8	2	6	8	10
9	1	6	8	10

REFERENCE DESIGNATIONS (NOTE 1)

C1 - C17
CR1 - CR11
Q1 - Q8
R1 - R44

WAVEFORMS



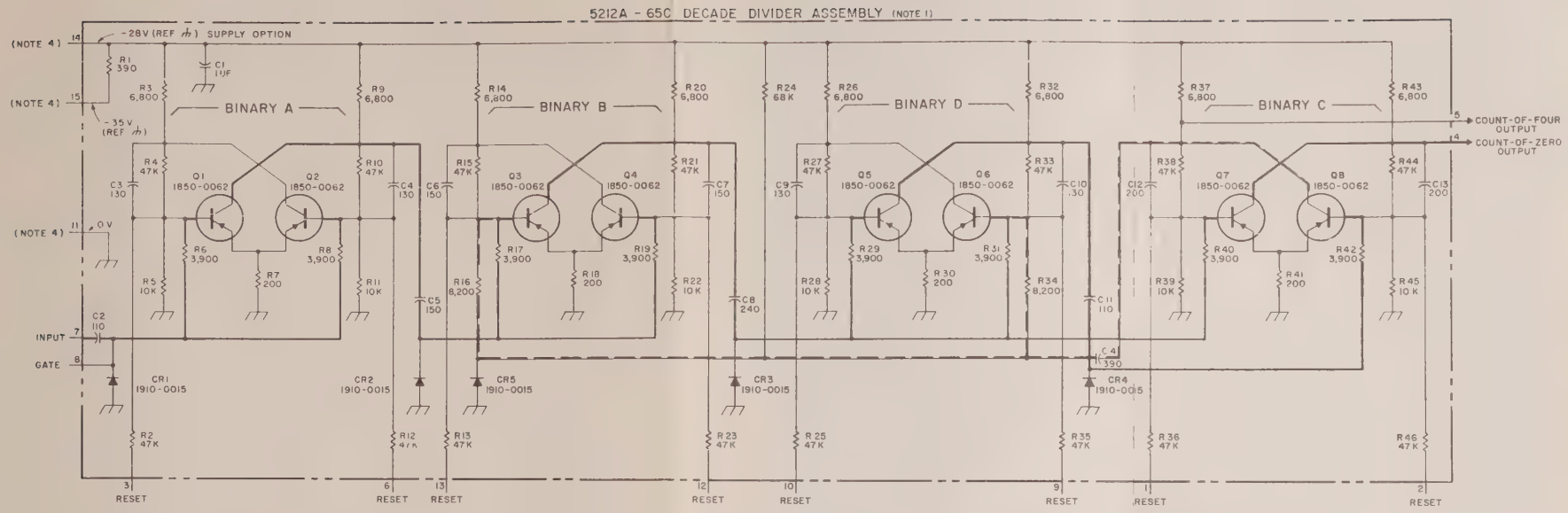


COPYRIGHT 1961 BY HEWLETT-PACKARD COMPANY

This drawing is intended for the operation and maintenance of Hewlett-Packard equipment and is not to be used otherwise or reproduced without written consent of the Hewlett-Packard Company.

5232A-65C-01R 8/7/61

FIGURE 3-8
DECADE DIVIDER ASSEMBLY
5232A-65C (A10)


5212A - 65C DECADE DIVIDER ASSEMBLY (NOTE 1)
-28V (REF ⏚) SUPPLY OPTION
-35 V (REF ⏚)
0 V
BINARY A
BINARY B
BINARY D
BINARY C
INPUT
GATE
COUNT-OF-FOUR OUTPUT
COUNT-OF-ZERO OUTPUT
RESET
NOTES
1. REFERENCE DESIGNATIONS WITHIN DECADE DIVIDER ASSY ARE INCOMPLETE; TO FORM COMPLETE REFERENCE DESIGNATION, ADD APPROPRIATE ASSEMBLY DESIGNATION (A_) AS PREFIX TO INDICATED DESIGNATION; ASSEMBLY DESIGNATION IS SHOWN IN FIGURE CAPTION AND ON OVERALL FUNCTIONAL SCHEMATIC
2. TYPICAL CIRCUITRY EXTERNAL TO DECADE DIVIDER ASSY IS SHOWN; FOR EXACT CONNECTION AND REFERENCE DESIGNATIONS OF EXTERNAL COMPONENTS, REFER TO OVERALL FUNCTIONAL SCHEMATIC
3. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS
4 INDICATED POWER SUPPLY VOLTAGES ARE RELATIVE TO ⏚ WITHIN ASSEMBLY; FOR VOLTAGES RELATIVE TO INSTRUMENT CHASSIS, REFER TO OVERALL SCHEMATIC OR POWER DISTRIBUTION DIAGRAM
WAVEFORMS
Q1 COLLECTOR
INPUT TO Q3-Q4
Q3 COLLECTOR
INPUT TO Q5,Q6,Q7
Q5 COLLECTOR
INPUT TO Q8
Q7 COLLECTOR
OUTPUT AT PIN 4 (AFTER CLIPPING & DIFFERENTIATING)
Q8 COLLECTOR
FEEDBACK TO Q3-Q6
8V
5V
4V
RESET WIRING
REFERENCE DESIGNATIONS (NOTE 1)
C1 - 14
CR1 - 5
Q1 - 8
R1 - 46
5212A - 65C DECADE DIVIDER ASSY
FRONT
BOTTOM
COMPONENT LOCATION

RESET NUMERAL	RESET PULSE (NEGATIVE) PIN CONNECTIONS			
0	3	13	10	1
1	6	13	10	1
2	3	12	10	1
3	6	12	10	1
4	3	12	10	2
5	6	12	10	2
6	3	13	9	2
7	6	13	9	2
8	3	12	9	2
9	6	12	9	2

COPYRIGHT 1961 BY HEWLETT-PACKARD COMPANY
This drawing is intended for the operation and maintenance of Hewlett-Packard equipment and is not to be used otherwise or reproduced without written consent of the Hewlett-Packard Company.
5212A 65C OR 8/4/6

FIGURE 3-9
DECADE DIVIDER ASSEMBLY
5212A-65C (A11-A16)

FIGURE 3-10
POWER SUPPLY ASSEMBLY
5212A-65G (A19)

WARRANTY

All our products are warranted against defects in materials and workmanship for one year from the date of shipment. Our obligation is limited to repairing or replacing products (except tubes) which prove to be defective during the warranty period. We are not liable for consequential damages.

For assistance of any kind, including help with instruments under warranty, contact your authorized hp Sales Representative for instructions. Give full details of the difficulty and include the instrument model and serial numbers. Service data or shipping instructions will be promptly sent to you. There will be no charge for repair of instruments under warranty, *except transportation charges.* Estimates of charges for non-warranty or other service work will always be supplied, if requested, before work begins.

CLAIM FOR DAMAGE IN SHIPMENT

Your instrument should be inspected and tested as soon as it is received. The instrument is insured for safe delivery. If the instrument is damaged in any way or fails to operate properly, file a claim with the carrier or, if insured separately, with the insurance company.

SHIPPING

On receipt of shipping instructions, forward the instrument prepaid to the destination indicated. You may use the original shipping carton or any strong container. Wrap the instrument in heavy paper or a plastic bag and surround it with three or four inches of shock-absorbing material to cushion it firmly and prevent movement inside the container.

GENERAL

Your authorized hp Sales Representative is ready to assist you in any situation, and you are always welcome to get directly in touch with Hewlett-Packard service departments:

CUSTOMER SERVICE

Hewlett-Packard Company
395 Page Mill Road
Palo Alto, California, U.S.A.
Telephone: DAvenport 6-1755
Direct Dial Area Code 415
TWX No. PAL AL 117-U
Cable: "HEWPACK"

OR (In Western Europe)

Hewlett-Packard S.A.
Rue du Vieux Billard No. 1
Geneva, Switzerland
Telephone: (022) 26. 43. 36
Cable: "HEWPACKSA"